Three decades later, Mt. St. Helens is wired with technology

At the time of the May 18, 1980, eruption, scientists were using slow, clunky tools. Now, a new generation of equipment has revolutionized the ability to peer into the heart of a volcano.

Sandi Doughton, Seattle Times, 5-22-10

The first earthquake rattled Mt. St. Helens on March 20, 1980 — nearly two months before the mountain erupted. But it took awhile for anyone to notice.

The sole seismometer on the peak was linked to an apparatus at the University of Washington that recorded squiggles on 16-mm film. Twenty minutes of chemical processing yielded an image so tiny scientists used a magnifying glass to make out details. A punch-card computer chugged for half an hour before spitting out an estimate of the epicenter.

On the 30th anniversary of St. Helens' epic May 18 blast, the Pacific Northwest is wired with more than 350 seismic sensors that make their predecessors look as primitive as Pac-Man. Able to take the Earth's pulse continuously and transmit data with lightning speed, they are part of a new generation of tools that has revolutionized the ability of scientists to peer into the heart of a volcano.

Surface and satellite sensors can now track with near-pinpoint precision the ground deformation that signals magma movement. Sophisticated gas sniffers analyze volcanic fumes for danger signals. "Smart" instrument packages can be quickly deployed on restless volcanoes to measure shaking and swelling and listen for explosions.

Coupled with three decades of research and experience, the new monitoring technologies are making it possible for scientists to predict some volcanic eruptions with a degree of accuracy many never dreamed possible.

But the tools don't work unless they're in the field. Many of the country's most dangerous volcanoes, including nine in the Pacific Northwest, are inadequately monitored, according to a U.S. Geological Survey analysis. Despite the Northwest's extensive network, there are only a couple of seismometers on Mt. Baker and Glacier Peak — and no ground motion sensors, said Tom Murray, director of the USGS Volcano Science Center.

USGS would like each of the nation's "very high-risk" volcanoes outfitted with a suite of more than 30 sensors, he said. The agency is seeking $15 million a year for the next decade to bolster what it calls a "National Volcano Early Warning System."

University of Washington seismologist Stephen Malone and his colleagues were taken by surprise 30 years ago when they confirmed the initial wake-up call from Mt. St. Helens. The next day, they loaded four seismometers into trucks and headed for the mountain. There was still so much snow on the ground, Malone installed one of the instruments in the outhouse at the Spirit Lake ranger station.

Snow, storms and ice are inherent challenges for volcanologists struggling to keep tabs on tall peaks. So is danger. Many of the new monitoring technologies offer ways to subvert foul weather and keep people out of harm's way.

In the 1980s, scientists measured ground swelling by hauling surveyor's gear up the volcano. They hammered rebar into the ground and used measuring tape to track widening fissures.

USGS volcanologist Dan Dzurisin jury-rigged an early tiltmeter using ceramic tile to create a flat surface, a pickle bucket to shield the instrument from falling ash, and fishing weights to hold it in place.

"The ground was shaking so much, I was afraid it was just going to shake off," he recalled. Today, volcanologists can sit in their offices and read signals from GPS sensors that detect ground motion down to the millimeter range. Radar-equipped satellites provide a broad view by taking images that can be compared over time.

"It literally gives you a picture from space of how much the ground has moved," Dzurisin said.

The detailed patterns of ground swelling reveal whether molten rock is ascending in a blob or squeezing up through cracks — and how close to the surface it is.

If the new tools had been available in 1980, scientists might have been able to spot accelerating ground motion and provide at least a few minutes' warning of the flank collapse that unleashed the most destructive eruption in U.S. history, Dzurisin said.

That will never be determined. But with the new instruments, there would have been no need for volcanologist David Johnston to be stationed high on the mountain, where he perished in the blast. Fifty-six other people died, many caught up by the mudflows that roared down surrounding valleys.

Long before the recent Icelandic eruption shut down airports across Europe and made "volcanic ash" a household word, St. Helens unleashed a plume that rose 15 miles and damaged at least two aircraft.

Satellites now track ash clouds around the world, though their usefulness is limited by orbital periods. Radar-equipped satellites, for example, can provide pictures only every 35 days.

USGS scientists in Alaska are experimenting with a portable, ground-based radar that could be stationed up to 20 miles from an erupting volcano to scan the ash cloud. The system can estimate the column's height and trajectory and possibly determine the density of particles — an important factor for officials trying to decide if it's safe to fly, said USGS volcanologist John Pallister.

Researchers are also beginning to mount radars and other instruments, such as gas-sniffers, on unmanned drones that can zigzag through volcanic plumes or cruise at low elevations hazardous for humans.

In 1980, gas analyzers were the size of microwave ovens. Today's versions fit in the palm of a hand. They still require scientists to fly through the plume in an airplane or helicopter. But on the horizon is an ultraviolet camera, used by astronomers, which is being adapted to take snapshots of volcanic plumes from the ground. The camera detects sulfur dioxide, a key gas that reflects the type of magma moving underground and the possibility of an explosive eruption.

"I think we're standing on the edge of a frontier of new methods and technologies that are beginning to come on line," Pallister said.

Sometimes nature still blows away man's technology, as in 2004 when Mt. St. Helens launched into an eruptive fit that lasted three years. Explosions destroyed all the sensors in the crater.

Scientists responded by quickly improvising portable stations called "spiders" that could be lowered from a helicopter. Now, they've improved the package, creating networks of "smart spiders" that can live for a year on battery power, communicate with each other and a heat-sensing satellite, and sort key data from the chaff of background noise.

The smart spiders will be put into action soon on Montserrat volcano in the West Indies, said USGS volcanologist Rick LaHusen.

Drawing on data from instruments installed in advance, and those hastily deployed after a volcano begins to stir, scientists have successfully predicted several eruptions over the last 20 years, including at cities and villages in the Philippines and Colombia, where residents were safely evacuated. When Mt. St. Helens started spitting in 2004, they were able to assure Northwesterners that nothing like 1980s cataclysm was likely.

One of the key warning signs seems to be a kind of low rumble that precedes many eruptions, and which new seismic methods have helped scientists understand.

There have been false alarms and misses — and cases where volcanoes went from a deep sleep to violent eruption in less than 24 hours.

That's why it's crucial to get instruments in the ground before a crisis starts, Dzurisin said.

If a volcano like Mt. Rainier begins rattling in winter, scientists may not be able to get additional sensors out in time.

"We can't afford to play catch-up with a volcano."